In the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application.

Claims 1-2 (Cancelled)

3. (Currently Amended) An apparatus for measuring one or more parameters of a diffracting structure and at least one underlying layer on a sample, said apparatus comprising:

a radiation source that emits broadband radiation;

a polarizing element, said radiation passing through said polarizing element toward said sample, said radiation being normally incident on and ~~reflected~~ diffracted ~~off~~ by said diffracting structure and at least one underlying layer on said sample, ~~the zero~~ a zeroth order ~~reflected~~ diffracted radiation passing through said polarizing element, at least one of said polarizing element and said sample are rotatable to produce a relative rotation between said polarizing element and said diffracting structure;

a spectrograph that detects the intensity of spectral components of said ~~zero~~ zeroth order ~~reflected~~ diffracted radiation after passing through said polarizing element at a plurality of polarization orientations between said polarizing element and said diffracting structure;

wherein said spectrograph produces a spectrograph signal for said spectral components ~~and~~ at a plurality of polarization orientations, said apparatus further comprising a computer system for analyzing said spectrograph signal to determine said one or more parameters of said diffracting structure and at least one underlying layer on said sample, said computer system comprising:

at least one computer connected to said spectrograph to receive said spectrograph signal; and

a computer program executed by said at least one computer, wherein said computer program includes instructions for:

extracting spectral information from said spectrograph signal;

~~constructing~~ obtaining an optical model simulating said diffracting structure and at least one underlying layer using at least one variable parameter;

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~~calculating~~ obtaining spectral information for said optical model; and

curve fitting said ~~calculated~~ spectral information for said optical model to said extracted spectral information to determine said one or more parameters of said diffracting structure and at least one underlying layer on said sample.

4. (Original) The apparatus of Claim 3, wherein said computer instructions for curve fitting comprise computer instructions for using a non-linear regression routine.

5. (Currently Amended) The apparatus of Claim 3, wherein said computer instructions for curve fitting comprise computer instructions for:

comparing said extracted spectral information and said spectral information for said optical model;

adjusting said at least one variable parameter of said optical model to form a new optical model;

~~recalculating~~ obtaining spectral information for said new optical model;

comparing said extracted spectral information and said ~~recalculated~~ spectral information for said new optical model; and

repeatably adjusting said at least one variable parameter to form a different optical mode, obtaining ~~recalculating~~ spectral information for said different optical model, and comparing said extracted spectral information and said ~~recalculated~~ spectral information for said different optical model until an acceptable fit is achieved.

6. (Currently Amended) The apparatus of Claim 3, wherein said computer instructions for ~~constructing~~ obtaining an optical model and ~~calculating~~ obtaining spectral information for said optical model comprise computer instructions for using rigorous coupled-wave analysis.

7. (Cancelled)

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8. (Currently Amended) The apparatus of Claim ~~7~~ 30, wherein said computer instructions for curve fitting comprise computer instructions for using a non-linear regression routine.

9. (Previously Presented) The apparatus of Claim 3, wherein said spectrograph comprises:

a dispersing element that disperses said polarized beam into spectral components; and

an array of detector pixels that detect the intensity of said spectral components.

10. (Previously Presented) The apparatus of Claim 3, wherein said polarizing element is a rotatable polarizing element that rotates relative to said diffracting structure.

Claims 11-12 (Cancelled)

13. (Currently Amended) A method of measuring at least one parameter of a diffracting structure and at least one underlying layer, said method comprising:

(a) passing broadband radiation through a polarizing element to produce polarized radiation;

(b) directing said polarized radiation to be normally incident with said diffracting structure, said polarized radiation being ~~reflected off~~ diffracted by said diffracting structure and at least one underlying layer;

(c) analyzing ~~the zero~~ a zeroth order ~~reflected~~ diffracted radiation with said polarizing element to produce an output beam with a polarity orientation;

(d) detecting the intensity of spectral components of said output beam;

(e) producing a relative rotation between said polarizing element and said diffracting structure to alter the orientation of said polarized element relative to said diffracting structure and repeating steps a through d;

(f) repeating step e for a plurality of orientations of said polarizing element and said diffracting structure; and

(g) using said detected intensities of said spectral components of said output beam for a plurality of orientations to determine said at least one parameter of said diffracting structure and at least one underlying layer.

14. (Currently Amended) The method of Claim 13, further comprising:

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generating a reference database of different diffracting structures having at least one variable parameter related to a plurality of wavelengths and a plurality of orientations;

comparing said detected intensities of said spectral components to said database to determine said at least one parameter of said diffracting structure and at least one underlying layer.

15. (Original) The method of Claim 13, wherein producing a relative rotation between said polarizing element and said diffracting structure comprises rotating said polarizing element.

16. (Original) The method of Claim 13, wherein producing a relative rotation between said polarizing element and said diffracting structure comprises rotating said diffracting structure.

Claims 17-27 (Cancelled)

28. (Currently Amended) An apparatus for measuring one or more parameters of a diffracting structure and at least one underlying layer on a sample, said apparatus comprising:

a radiation source that emits broadband radiation, said radiation is normally incident on said diffracting structure;

a polarizing element in the beam path of said broadband radiation, wherein said radiation passes through said polarizing element toward said sample, said radiation is ~~reflected off~~ diffracted by said diffracting structure on said sample, ~~the zero~~ a zeroth order ~~reflected~~ diffracted radiation passing through said polarizing element, said polarizing element being rotatable to produce a relative rotation between said polarizing element and said diffracting structure;

~~an r-θ~~ a rotating sample stage for holding said sample with said diffracting structure; ~~and~~

a spectrograph that detects the intensity of spectral components of the ~~zero~~ zeroth order radiation ~~reflected off~~ diffracted by said diffracting structure and at least one underlying layer; and

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a processor for comparing the detected intensity of spectral components of the zeroth order radiation to calculated intensity of spectral components for an optical model of the diffracting structure and at least one underlying layer to determine the one or more parameters of the diffracting structure and at least one underlying layer.

Claim 29 (Cancelled)

30. (New) The apparatus of Claim 3, wherein said computer instructions for extracting spectral information from said spectrograph signal comprise computer instructions for:

calculating the sample reflectance for a plurality of wavelengths of said radiation at a plurality of polarization orientations of said polarizing element relative to said diffracting structure; and

curve fitting said sample reflectance for said plurality of wavelengths at said plurality of orientations

31. (New) The apparatus of Claim 30, wherein curve fitting said sample reflectance for said plurality of wavelengths at said plurality of orientations is performed with:

$$R(\Theta) = A \cdot \cos^4(\phi - \Theta) + B \cdot \sin^4(\phi - \Theta) + C \cdot \cos^2(\phi - \Theta) \cdot \sin^2(\phi - \Theta)$$

where $R(\Theta)$ is the measured reflectance at one wavelength, Θ is the polarization orientation of said polarizing element with respect to said diffracting structure, and ϕ, A, B, and C, are measurable to obtain said spectral information.

32. (New) The apparatus of Claim 3, further comprising a sample stage, said sample being held on said sample stage, wherein said sample stage rotates said diffracting structure relative to said polarizing element.

33. (New) The apparatus of Claim 32, wherein said sample stage is an r-θ stage.

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